

**Title:** Modelling Human papilloma virus (HPV) with agent-based models:  
HPVSim development and application to England

**Description:**

During the COVID-19 pandemic, mathematical and statistical modelling has been very useful in informing and advising policy decision making. Utilising existing methods across different disciplines and furnishing them with novel adaptations has been an important part of the pandemic response over the last three years. One stream of modelling that has been popularised during the pandemic is agent-based or individual-based models (ABMs/IBMs). Notably, Covasim [1] is an ABM that was developed in early 2020 to model the transmission of different SARS-CoV-2 strains and incorporate interventions such as contact tracing which are difficult to model with population-based compartmental models. Covasim has been widely used to track the COVID-19 epidemic across a number of countries. Notably in the UK it has been used to provide ongoing informed scientific advice to the UK Health Security Agency and the Department of Health and Social Care.

This project will utilise the knowledge from the technical framework and the development of Covasim, to develop an England specific ABMs to model the transmission and vaccination against Human Papilloma Virus (HPV). A prototype model called HPVSim has been built recently, and within the project this prototype will be tested and further developed. Importantly, the aim of the work is to adapt the design to develop an HPVSim for England – taking care of the correct HPV transmission networks for this setting and modelling the current vaccination strategies against HPV [2] as well as future possible extensions.

The work of the project will comprise some of the following, depending on the student's interests:

- 1) Undertaking of a systematic review of HPV modelling and convince yourself of the advantage of using an ABM over compartmental model for HPV transmission.
- 2) Learning to use the Covasim technical framework and building a simple Oxford University model taking care of the networks you want to include. Can be an adaptation of the application of Covasim to Boston University in [3].
- 3) Learning to use the HPVSim modeling and noting the differences between Covasim and HPVSim.
- 4) Undertaking a scoping/systematic review of existing vaccines and possible future candidates.
- 5) Developing HPVSim for England based on the transmission network modelled in [2] and what we learned about current and possible vaccine candidates.

There is a scope to change/adapt/extent the above points if there is a direction that the student is particularly interested in exploring. Please get in touch with Jasmina if this is the case.

Outputs from the project could be used to offer informed advice to the Joint Committee for Vaccination and Immunisation (JCVI) who evaluate all the immunisation programmes in

England, and its HPV sub-committee who evaluate the ongoing HPV immunisation programme.

**References:**

1. Covasim technical paper

<https://journals.plos.org/ploscompbiol/article/metrics?id=10.1371/journal.pcbi.1009149#citationHeader>

2. Modelling HPV in England <https://pubmed.ncbi.nlm.nih.gov/29307388/>

3. Modelling COVID-19 spread in Boston University

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2781349>

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